DOCUMENT RESUME

ED 293 729 SE 049 118

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TITLE Evaluation of Process Science Skills: From the Real World to the Ideal World.
PUB DATE Apr 88
NOTE 9p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 5-9, 1988).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Educational Assessment; Elementary School Science; Elementary Secondary Education; *Evaluation Criteria; *Evaluation Needs; *Process Education; Science Education; *Science Tests; *Secondary School Science; Skill Development
IDENTIFIERS *Science Education Research; *Science Skills

ABSTRACT

State legislatures and others are recommending and, in some cases, mandating reforms in education including evaluating students' ability to meet stated objectives. This "ideal" situation poses a major problem concerning instruments needed to assess process skills. In the real world, educators do not yet have nationally recognized, valid, reliable, and efficient instruments to measure process skills. This paper discusses issues involved in papers presented at a symposium at the 1988 meeting of the American Educational Research Association. Papers discussed include: (1) "Testing for Higher Order Understanding in Science" (Michael Padilla); (2) "Classroom Measurement of Process Skills as a Key Element in the Evaluation of Student Learning" (D. S. G. Carter and R. G. Hacker); (3) "Creating the Process of Measuring Process Skills" (Ronald Houser); (4) "Developing Quality Science Programs: A Staff Development Project for the Improvement of Curriculum, Instruction, Assessment" (Allan Olson and Susan Smoyer); (5) "Science Process Evaluation Model" (Larry Small); and (6) "Assessment of Science Process Skills at the State of the Art Level" (Norman Stenzel). (CW)

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Discussion of Papers Presented at a Symposium at the Annual Meeting of the American Educational Research Association
New Orleans, LA
April, 1988

SE049118

Evaluation of Process Science Skills: From the Real World to the Ideal World

Shelley Ann Lipowich

State legislatures are mandating reforms in education. They are stating that school districts must publicly state their objectives, evaluate their students' meeting of those objectives, publicly report their results, and devise school improvement plans based on this process. In accordance with the National Science Teachers Association's recommendations, Science-Technology-Society: Science Education for the 1980's, some states are mandating, in their reform packages, the teaching of "process" science as a part of the total science program.

This ideal-world mandate, however, poses a major problem: the instruments to evaluate "process" science are still very much "state-of-the-art". The state of the real-world, at this time, is that educators do not have nationally recognized, valid, reliable, and efficient (paper and pencil) instruments to assess all of the process science skills that states have mandated be taught and tested. Educational researchers, policy makers, and practitioners are now in the process of dealing with this real-world problem of science assessment of process skills at the district, state, regional, national, and international level. Some researchers and policy makers in different states and countries have been working in the area of assessing process science skills for many years. The products of their research and experience can help other educators begin to translate research into practice.

Michael Padilla, in his paper "Testing for Higher Order Understanding in

Science", cites John Bransford's work and stresses the need to identify and define the problem in any kind of problem solving (Padilla, 1988). This identification and definition process is needed within any group discussing any problem. Researchers, administrators, teachers, and students within a given group need to have a common language if they are to discuss a common problem.

This concept of using a common language is one of the most critical concepts in assessing science process skills. Padilla uses the definitions from Science - A Process Approach (S-APA) (S-APA, 1965). Allen Olson, Director of the Northwest Evaluation Association's Science Curriculum and Assessment Project, supplies the operational definitions used for the Project's "Concepts" and "Processes" with the items in the Project's Item Bank (Olson, 1988). Larry Small supplies operational definitions for the science processes assessed in his district, Schaumburg Community Consolidated District #54 in Schaumburg, Illinois (Small, 1988). Roger Hacker operationally defined each process science category in the Science Lesson Analysis System (SLAS) (Hacker, 1984). In supplying operational definitions with their assessment instruments, Padilla, Olson, Small, and Hacker make it possible for others to understand and utilize their work.

One of the major problems of writing or collecting process science assessment items is the question of content versus process. Ralph W. Tyler has stated that a behavioral objective needs to be content specific and grade level specific. Oregon's project allows for both content and process by having

separate "content categories," "process categories", and "concept categories". The basic question, however, remains: "Can one really assess process without content?"

In setting up situational questions, the "set-up" of the question can become very "wordy", and the item may end up having a very heavy "test of reading ability" component. Padilla comments on this question of reading difficulty and the steps taken to counteract the difficulty in the construction of the Middle Grades Integrated Process Skill Test (MIPT), intended for students in Grades 6-9 (Padilla, 1988). Students in a given grade in a given district might well be reading below grade level. Where an assessment's purpose is to show that all students are achieving a given process skill, reading level is definitely a factor to consider.

One of the major issues still to be answered is whether a paper and pencil test can really test process skills. Is the process being tested, or is recognition or recall of the process being tested when a student has to choose between "given" responses? Yet, to observe a student going through a process, to question that student about that process, to uniformly decide whether the student has "successfully" gone through the process requires more staff training, hours, and dollars than most local districts or states can afford to, or are willing to, spend. This "observational" process of evaluation is not "efficient" with large numbers of students. The question then becomes, is there a process of evaluation that is efficient, and is also valid and reliable? Norman Stenzel suggests that computer-based strategies have "a good chance to be

more valid" than paper and pencil tests "in respect to the dynamics of processes" (Stenzel, 1988). Stenzel also points out another very critical issue: what is "new" for one student may well be "recall" for another student. This issue of a student's prior knowledge is one of the most difficult to ascertain and cannot easily be addressed in a paper and pencil, multiple choice format. One student may truly be "predicting", while another, giving an identical surface response, may be "recalling".

The question of construct validity is always prime. Is the item measuring what it purports to measure, or is it measuring some other attribute? Validity is measured most often by "experts" who match assessment items to assessment objectives, or to skill and knowledge statements, giving a face validity. However, Padilla has attempted to establish construct validity. The Georgia group has correlated the Test of Graphing in Science (TOGS) (McKenzie and Padilla, 1986) to a "pencil and paper graphing task" and obtained a correlation of .73 with 69 students (Padilla, 1988). Cronin, Padilla, and Twiest undertook a validity study of their Test of Basic Process Skills (BAPS) using an interview technique with 32 students, but got very mixed results. They are currently reassessing BAPS with a new, different interview instrument. Padilla notes the importance of developing individual interview and station study items to validate paper and pencil items. The difficulty of what these researchers are attempting is enormous, but their example and methodology can be enormously helpful to others. In the ideal-world, every researcher developing an instrument for assessment would show construct validity. In the real-world, one is fortunate to

have "experts" to grant face validity.

In the real-world, the local district, charged with developing a local assessment instrument to assess its local objectives, has the most difficult task. Larry Small put together a team in Schaumburg Elementary District #54, Schaumburg, Illinois, to develop assessment instruments for process science skills in Grades 3, 6, and 8, as mandated by the State of Illinois. Their model of cooperation: with university level researchers, such as Padilla, in Georgia, and John Staver, in Illinois; with Illinois State Board of Education evaluation personnel, such as Norman Stenzel; with district testing experts such as Joyce Zitnan, Fred Tarnow, Marianne Zito, Mary Kelly, and the many, expert, process science teachers in Schaumburg District 54 and Hinsdale Elementary School District 181; is a model other large districts could follow.

The Oregon Project is able to provide valuable resources to any group that would like to develop its own assessment instrument; its Item Development and Review Process set up excellent methods of procedure. Smaller districts, without "test experts" are getting assistance with some of these procedures by banding together and working with such groups as state Educational Service Centers.

One of the largest studies done of process science skills was done in Australia; the study was first done in science and then its methodology was extended into social studies. The methodology is far different from the paper and pencil forms discussed elsewhere in this grouping of studies. The methodology is that of observers entering actual classrooms and observing,

classifying, and recording interactions between and among students and teachers. The "SLAS data can be used to confirm the extent to which students are afforded the opportunity to develop, practice and refine emergent intellectual abilities in science classrooms" (Carter & Hacker, 1988). What is particularly striking, however, is that Carter's and Hacker's "intellectual abilities practiced" in Australia are "science process skills" in the United States. Carter and Hacker also record non-verbal interactions with science materials and multi-media materials. Since a user's manual and a full observer training program were developed with the SLAS, one could "transport" the system to the United States and see how American interactions correlated with Australian.

There is no "one best way" to begin assessing process science skills. State and local purposes for assessment are different, yet cooperation and attention to "ways" of beginning to assess these skills are bringing us many additional benefits. Both the Oregon model and the Illinois model are far more than assessment models; both include staff development, curriculum improvement, and instructional improvement within their frameworks. Regional centers working with large groups of teachers from many local school districts are seeing a real growth in understanding of what "process science" is. As teachers, administrators, and consultants together address the question of "how can we measure process science skills?", all of us begin to better understand "what process science is" for different age groups and for different backgrounds. In the best of both worlds, going through the process brings us to an understanding of what the process is.

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